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First Named Inventor	Mitsunori SAKAMA
Group Art Unit	1762
Examiner Name	M. Padgett
Attorney Docket Number	0756-1799

ENCLOSURES *(check all that apply)*

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  - ☐ Affidavits/declaration(s)
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Remarks

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Docket No. 0756-1799

AF/1762
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:	)	Group Art Unit: 1762
Mitsunori SAKAMA	)	Examiner: M. Padgett
Serial No. 09/070,908	)	CERTIFICATE OF MAILING
Filed: May 4, 1998	)	I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on: June 9, 2004.
For: FILM FORMING METHOD AND FILM FORMING APPARATUS	)	Adele M Stamper

SUPPLEMENTAL APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 35 U.S.C. § 134 and 37 C.F.R. § 1.192(a), Appellant submits this Appeal Brief in triplicate to appeal the examiner's final rejection of claims 23-29, 31-50 and 58-129 in the Official Action mailed November 27, 2002 (Paper No. 37), the Advisory Action mailed May 12, 2003, and the "Supplement to Paper No. 37" mailed March 9, 2004. (A telephone conversation was held on March 19, 2004, between the appellants' representative and Examiner Padgett. Examiner Padgett is thanked for her time in discussing the status of the case. Examiner Padgett noted that the "Supplement to Paper No. 37" mailed March 9, 2004, was necessary to correct the record with regard to the status of dependent claims 105, 111 and 112. It was agreed that a further Notice of Appeal would not be necessary in the present application, and that upon filing of the present Supplemental Appeal Brief, that the Examiner will prepare an Examiner's Answer.)

TABLE OF CONTENTS

I. REAL PARTY IN INTEREST

The named inventors have assigned all ownership rights in the pending application to Semiconductor Energy Laboratory Co., Ltd., 398, Hase, Atsugi-shi, Kanagawa-ken, 243-0036, Japan, which is the real party in interest.

II. RELATED APPEALS AND INTERFERENCES

The appellants, their legal representatives, and the assignee are not aware of any other pending appeals or interferences which will directly affect or be directly affected by, or have a bearing on the Board's decision in this appeal.

III. STATUS OF THE CLAIMS

Claims 23-29, 31-50 and 58-129 are pending in the present application, of which claims 23-29, 58, 64, 70, 76, 82, 87, 92 and 98 are independent. No claims have been deemed allowable by the examiner.

IV. STATUS OF AMENDMENTS

All prior amendments are believed to have been entered in the present application. Thus, the status of the claims in this application is as set forth above and in Appendix A.

V. SUMMARY OF THE INVENTION

The present invention relates to a film forming method comprising the steps of supplying a discharge gas (*e.g.* hydrogen gas (H_2) through gas supply system 18) into a chamber (*e.g.* decompression chamber 10), supplying radio frequency (RF) energy in the chamber to generate plasma from the discharge gas by radio frequency discharge, supplying a reactive gas (*e.g.* silane gas (SiH_4) through gas supply system 17) into the chamber at a same flow rate (*e.g.* 100 sccm, *see also* Figs. 2A, 5 and 7) as supplying the discharge gas, and forming a semiconductor film (or a gate insulating film or an under film, *see also e.g.* Figs. 3A-3D and 4A-4D) over a substrate (*e.g.* an insulating substrate) in the chamber by decomposing the reactive gas using the radio frequency energy, where the step of supplying the discharge gas is discontinued with a start of the step of supplying the reactive gas and throughout the forming of the semiconductor film, and where an overall

flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas (*see, e.g.* Fig. 2A, start point of film formation 21, p. 19, ¶4 to p. 20, ¶2; Fig. 7, start point of film formation 71, p. 30, ¶3-5; claims 23, 24, 26, 28, 58, 70, 82 and 92). As a result, it is possible to eliminate instability at a start of the radio frequency discharge, and the film formation can be carried out in the state where the radio frequency discharge is always stable.

The present invention is also directed to an end point of film formation, i.e. where an overall flow rate of gases supplied in a chamber is maintained during a transition from a reactive gas to a discharge gas (*see, e.g.* Fig. 5, end point of film formation 52, p. 22, ¶3-6; Fig. 7, end point of film formation 72, p. 30, ¶3-5). Specifically, the present invention is also directed to a film forming method comprising the steps of forming a semiconductor film over a substrate in a chamber by decomposing a reactive gas using radio frequency energy supplied in the chamber, supplying a discharge gas into the chamber at a same flow rate as supplying the reactive gas, and supplying the radio frequency energy to the discharge gas to maintain plasma from the discharge gas in the chamber by radio frequency discharge, where the reactive gas is supplied into the chamber during the step of forming of the semiconductor film before the step of supplying the discharge gas, where the step of supplying the discharge gas is started with discontinuing a supply of the reactive gas, and where an overall flow rate of gases supplied in the chamber is maintained during a transition from the reactive gas to the discharge gas (claims 25, 27, 29, 64, 76, 87 and 98). In finishing the film formation, for a predetermined period of time, plasma without the film formation is maintained in the chamber. Also, the radio frequency discharge is stopped in the state where minute particles in the chamber are exhausted. As a result, a desirable condition is achieved such that minute particles do not adhere to the formed surface.

VI. STATEMENT OF ISSUES

A. Whether claims 23-29, 31-50, 58-129 are not *prima facie* obvious based on the combination of U.S. Patent No. 5,420,044 to Kozuka, U.S. Patent No. 6,289,843 B1 to Gupta et al. and U.S. Patent No. 5,456,796 to Gupta et al., or further in combination with U.S. Patent No. 5,366,926 to Mei et al., U.S.

Patent No. 5,346,850 to Kaschmitter et al. and/or U.S. Patent No. 5,313,076 to Yamazaki et al.

B. Whether, under the doctrine of obviousness-type double patenting, claims 23-29, 45-50, 58-129 are not an obvious variation of or are patentably distinct from the combination of either claims 1-63 of U.S. Patent No. 6,281,147 B1 to Yamazaki et al., or claims 1-5, 12-21 and 27-30 of U.S. Patent No. 6,015,762 to Yamazaki et al., Gupta '843 and/or Kozuka.

VII. GROUPING OF CLAIMS

The rejected claims shall stand or fall together.

VIII. ARGUMENTS

A. Whether claims 23-29, 31-50, 58-129 are not *prima facie* obvious based on the combination of U.S. Patent No. 5,420,044 to Kozuka, U.S. Patent No. 6,289,843 B1 to Gupta et al. and U.S. Patent No. 5,456,796 to Gupta et al., or further in combination with U.S. Patent No. 5,366,926 to Mei et al., U.S. Patent No. 5,346,850 to Kaschmitter et al. and/or U.S. Patent No. 5,313,076 to Yamazaki et al.

To establish a *prima facie* case of obviousness, (1) there must be some suggestion or motivation (either in the references themselves or in the knowledge generally available to one of ordinary skill in the art) to combine the reference teachings; (2) there must be a reasonable expectation of success; and (3) the prior art references when combined must teach or suggest all the claim limitations. *See* MPEP §§ 2142-43. Once a *prima facie* case of obviousness has been made by the Patent Office, the burden then shifts to the Applicant to rebut that *prima facie* case. This rebuttal can include any arguments or presentation of evidence that is pertinent to the issue of unobviousness including, for example, comparison of test data showing unexpected properties not present in the prior art or that the prior art is so deficient that there is no motivation to make what might appear to be obvious changes. See *In re Dillon*, 16 U.S.P.Q.2d 1897, 1901 (Fed. Cir. 1990); MPEP § 2142. For the reasons that follow, it is respectfully submitted that a *prima facie* case of obviousness cannot be maintained in this application.

Paragraph 3 of the Official Action mailed November 27, 2002 (referring to Paper No. 30), and as amended by the "Supplement to Paper No. 37" mailed March 9, 2004, rejects claims 23-29, 45-50, 58, 59, 61-65, 67-82, 84-87, 89-129 as obvious based on the combination of U.S. Patent No. 5,420,044 to Kozuka, U.S. Patent No. 6,289,843 B1 to Gupta et al. and U.S. Patent No. 5,456,796 to Gupta et al. Paragraphs 4 and 5 (also referring to Paper No. 30) reject claims 31-44, 60, 66, 83 and 88 as obvious based on the combination of Kozuka, Gupta '843, Gupta '796, U.S. Patent No. 5,366,926 to Mei et al., U.S. Patent No. 5,346,850 to Kaschmitter et al. and/or U.S. Patent No. 5,313,076 to Yamazaki et al. As it is believed independent claims 23-29, 58, 64, 70, 76, 82, 87, 92 and 98 are patentably distinguished from Kozuka, Gupta '843 and Gupta '796, the dependent claims above will not be separately argued and are believed to be allowable for the same reasons as to the independent claims from which they depend.

The Applicant respectfully contends that the Official Action has failed to set forth a *prima facie* case of obviousness. Kozuka, Gupta '843 and Gupta '796, either alone or in combination, do not teach or suggest either supplying a reactive gas into a chamber at a same flow rate as supplying a discharge gas, where an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas (*see*, *e.g.* Fig. 2A, start point of film formation 21, p. 19, ¶4 to p. 20, ¶2; Fig. 7, start point of film formation 71, p. 30, ¶3-5; claims 23, 24, 26, 28, 58, 70, 82 and 92), or vice-versa, i.e. supplying a discharge gas into a chamber at a same flow rate as supplying a reactive gas, where an overall flow rate of gases supplied in the chamber is maintained during a transition from the reactive gas to the discharge gas (*see*, *e.g.* Fig. 5, end point of film formation 52, p. 22, ¶3-6; Fig. 7, end point of film formation 72, p. 30, ¶3-5).

The present invention discusses the importance and significance of maintaining the overall flow rate of gases supplied in the chamber at the start point of film formation (*see generally*, Embodiment 1, pp. 16-20). Specifically, the start point of film formation is shown in Figs. 2A, and described as follows: "the total amount of gas supplied into the inside of the chamber 10 does not change" (p. 19, ¶4) thus preventing "the change of pressure in the atmosphere at the time when the supply of the hydrogen gas is converted to the supply of the silane gas" (p. 19, ¶5). This is important in that it suppresses "the lowering of film quality of the amorphous silicon film which is otherwise

caused by excess hydrogen taken into the formed amorphous silicon film" (p. 20, ¶1) and "the instability at the start of discharge does not have an influence on the film formation" (p. 20, ¶2). As stated in the independent claims and shown in Fig. 2A, the reactive (*e.g.* silane) gas is supplied at the same flow rate as the discharge (*e.g.* hydrogen) gas, *e.g.* 100 sccm, and the overall flow rate of gases supplied in the chamber is maintained during a transition 21 from the discharge gas to the reactive gas. For example, the flow rate of the hydrogen gas plus the flow rate of the silane gas equals 100 sccm.

The present invention also discusses the importance and significance of maintaining the overall flow rate of gases supplied in the chamber at the end point of film formation (*see generally*, Embodiment 2, pp. 20-24). By making "the pressure change in the chamber due to the conversion of gas ... as small as possible ... it is possible to stop the film formation in the state where the discharge is maintained (state where plasma is produced)" (p. 22, ¶4-5), "it is possible to make the state where minute particles do not exist in the atmosphere in the state where the discharge is stopped, and it is possible to prevent the minute particles from adhering to the surface of the formed film" (p. 23, ¶3). As stated in the independent claims and shown in Fig. 5, the discharge (*e.g.* hydrogen) gas is supplied at the same flow rate as the reactive (*e.g.* silane) gas, *e.g.* 100 sccm, and the overall flow rate of gases supplied in the chamber is maintained during a transition 52 from the reactive gas to the discharge gas. Again, for example, the flow rate of the hydrogen gas plus the flow rate of the silane gas equals 100 sccm.

Still further, the present invention discusses the importance and significance of maintaining the overall flow rate of gases supplied in the chamber at both the beginning point and the end point of film formation (*see generally*, Embodiment 5, pp. 29-30). Again, the present inventor notes the importance of maintaining constant pressure between introduction of the discharge gas and the reactive gas and vice-versa. "[It] is preferable that the pressure change in the atmosphere due to conversion of gas is as small as possible. ... By doing so, it is possible to prevent the instability at the start of discharge from affecting the film formation and to prevent minute particles after film formation from adhering to the surface of the film" (p. 30, ¶3 and ¶6). As stated in the

independent claims and shown in Fig. 7, the reactive (*e.g.* silane) gas is supplied at the same flow rate as the discharge (*e.g.* hydrogen) gas, *e.g.* 100 sccm, the overall flow rate of gases supplied in the chamber is maintained during a transition 71 from the discharge gas to the reactive gas, the discharge (*e.g.* hydrogen) gas is supplied at the same flow rate as the reactive (*e.g.* silane) gas, *e.g.* 100 sccm, and the overall flow rate of gases supplied in the chamber is maintained during a transition 72 from the reactive gas to the discharge gas. Again, for example, the flow rate of the hydrogen gas plus the flow rate of the silane gas equals 100 sccm.

Kozuka, Gupta '843 and Gupta '796, either alone or in combination, simply do not teach or disclose the above-referenced features of the present invention, nor do the prior references recognize the importance and significance of supplying reactive and discharge gases at a same flow rate where an overall flow rate of the gases is maintained during a transition from the reactive gas to the discharge gas or vice-versa.

As noted in MPEP § 2142, the initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). It is respectfully submitted that Kozuka, Gupta '843 and Gupta '796 fail to expressly or impliedly suggest either supplying a reactive gas into a chamber at a same flow rate as supplying a discharge gas, where an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas, or vice-versa, i.e. supplying a discharge gas into a chamber at a same flow rate as supplying a reactive gas, where an overall flow rate of gases supplied in the chamber is maintained during a transition from the reactive gas to the discharge gas, and it is further submitted that the examiner has not presented a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.

It is respectfully submitted that there has been an insufficient showing that one of skill in the art would have been motivated to modify the reference or to combine

reference teachings to achieve the claimed invention. Kozuka clearly expresses a preference for the use of a gas mixture. Furthermore, the Official Action states that "either Gupta et al. shows that it is possible to achieve the objective of Kozuka . . . via switching from inert gas to reactant gas, instead of maintaining the inert or diluent gas flow throughout the sequence." While the Official Action relies on various teachings of the cited prior art to disclose aspects of the claimed invention and asserts that these aspects could be used together, it is submitted that the Official Action does not adequately set forth why one of skill in the art would combine the references to achieve the present invention. It is unclear why one of skill in the art would look to Gupta to modify the teachings of Kozuka and to "achieve the objectives of Kozuka" when those objectives are already met by the disclosure of Kozuka. MPEP § 2142 states: "The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done. 'To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.' *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985)."

Also, it should be noted that the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680 (Fed. Cir. 1990). In other words, simply because the references can be combined does not mean that they should be combined. Thus, simply because one could combine and modify the teachings of Kozuka, Gupta '843 and Gupta '796, does not mean one of skill in the art would do so absent some suggestion of the desirability of doing so.

It is respectfully submitted that the teachings of Kozuka and Gupta are insufficient to teach or suggest to one of skill in the art that a discharge gas should not be mixed with a reactive gas, or that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. At best, the prior art of record teaches that a discharge gas might be mixed with a reactive gas, or that an overall flow rate of gases

supplied in the chamber might be maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas, but not that the should be. *See* MPEP § 2143.01, under the heading "FACT THAT REFERENCES CAN BE COMBINED OR MODIFIED IS NOT SUFFICIENT TO ESTABLISH *PRIMA FACIE* OBVIOUSNESS," wherein it is stated that "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination."

Furthermore, the prior art does not teach or suggest all the claim limitations, the third prong required to establish a *prima facie* case of obviousness as discussed above. Kozuka, Gupta '843 and Gupta '796 fail to teach or suggest either supplying a reactive gas into a chamber at a same flow rate as supplying a discharge gas, where an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas, or vice-versa, i.e. supplying a discharge gas into a chamber at a same flow rate as supplying a reactive gas, where an overall flow rate of gases supplied in the chamber is maintained during a transition from the reactive gas to the discharge gas. Accordingly, even if Kozuka could be combined with Gupta '843 and Gupta '796, it is respectfully submitted that the combination would not teach or suggest all of the limitations recited in the pending claims.

Kozuka discloses that the raw material gas is preferably used not singly but as a mixture with a diluting gas during the film formation (see col. 4, lines 40-42). On the other hand, independent claims 23, 24, 26 and 28 recite that the step of supplying said discharge (hydrogen) gas is discontinued with a start of the step of supplying said reactive gas; independent claims 25, 27 and 29 recite that the step of supplying said discharge (hydrogen) gas is started with discontinuing a supply of said reactive gas; independent claims 58, 70, 82 and 92 recite that said discharge gas is not supplied during the step of supplying said reactive gas; and independent claims 64, 76, 87 and 98 recite that said reactive gas is not supplied during the step of supplying said discharge gas. In other words, the claimed invention has a feature that the discharge gas is not mixed with the reactive gas as can be seen in all the independent claims. The Official Action asserts that the prior art teaches that a reactant gas "may or may not" be mixed with a diluting gas (p. 3, Paper No. 37). The Official Action cites col. 5,

lines 31-50 and col. 6, lines 61-68 of Gupta '796 and col. 5, lines 5-15 of Gupta '843 to support this assertion. However, it is not at all clear how the combined prior art supports this assertion. At best, Gupta '796 and Gupta '843 suggest that the flow of an inert gas may be stopped and the flow of a process gas may be started. This is not the same as the present invention which includes a feature that the discharge gas is not mixed with the reactive gas. In any event, by teaching that it is preferable to use a mixture of a diluting gas and a reactant gas, Kozuka teaches away from the present invention. This is the case even if the diluting gas of Kozuka is equivalent to the discharge gas of the present invention.

As previously submitted, the independent claims recite that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. This feature is supported by the timing chart of Fig. 7 and in the fourth paragraph on p. 19 of the specification. Further, this feature contributes in preventing the change of pressure in the atmosphere at the time when the supply of the hydrogen gas is converted to the supply of the silane gas as described in the fifth paragraph on p. 19.

Kozuka may teach that a pressure of the I-layer forming chamber 104 is made the same as that of the N-layer forming chamber 103 from col. 5, line 66 to col. 6, line 1. However, it should be noted that the above disclosure has nothing to do with maintaining the pressure during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. Also, it appears that Kozuka fails to teach that the overall flow rate of gases supplied in the chamber is maintained during the above-referenced transition. Therefore, the Applicant respectfully submits that Kozuka, either alone or in combination with any of the cited prior art, does not teach or suggest that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas.

The Official Action contends that Gupta '843 "would suggest to the competent workmen that one not create discontinuities in the flow rate at the gas change over (transition), which is consistent with maintaining the pressure throughout the process in Kozuka" (p. 4, Paper No. 37, citing Gupta '843 at col. 2, lines 54-58, etc.). However,

Gupta '843 does not specifically mention a "change over" or a "transition" between the two gas inputs. The prior art is silent about the claimed gas flow rate during the transition period and does not appear to recognize the importance of maintaining an overall flow rate of gases supplied in a chamber during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. As such, the Applicant respectfully submits that Gupta '843 is not appropriate to support the above modification of Kozuka.

Kozuka discloses that the raw material gas is preferably used not singly but as a mixture with a diluting gas during the film formation (column 4, lines 40-42). On the other hand, in accordance with the presently claimed invention, the discharge gas is not mixed with the reactive gas, which is clearly recited in all of the independent claims. After quoting from this portion of Kozuka and emphasizing the word "preferably," the Official Action asserts on page 3 that "it is noted that preferably does not mean its necessary, but that its optional and singly is possible, if not preferred." It is respectfully submitted, however that this is a non sequitur. Kozuka clearly states that it is preferable that the raw material gas is used as a mixture with a diluting gas. While this may not mean it is necessary, there is no logical inference in the reference that supports a conclusion that one of skill in the art would conclude that this would be optional, and thus using the gas alone could be possible, if not preferred. The Official Action takes the clear, literal disclosure of Kozuka that a mixture is preferred and apparently concludes that using the gas alone (singly) may be preferred. It is respectfully submitted that this goes beyond the reasonable interpretation of the disclosure of Kozuka as a whole and that the conclusion that the diluting gas of Kozuka need not have been mixed with reactant gas is based on the hindsight because Kozuka fails to disclose or suggest that the discharge gas is not mixed with the reactive gas.

Furthermore, "preferable" has at least one definition of "more desirable or worthy than another" (http://www.dictionary.com). Thus, it is submitted that Kozuka, when taken for all that it discloses, clearly teaches one of skill in the art that the use of a mixture of raw material gas and diluting gas is more desirable than the use of a raw material gas alone. In this regard, Applicant believes that Kozuka in fact teaches away

from the claimed invention, even if the diluting gas of Kozuka is equivalent to the discharge gas of the subject application.

According to pages 5-6 of the Official Action, Gupta '843 is relied upon for providing both teaching and motivation to maintain uniform flow of gases between steps. All of the independent claims recite that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. This feature is supported by the timing chart of Figure 7 and on page 19, lines 10-16 of the specification. On the other hand, although Gupta '843 may teach that a rate during step 215 is substantially equal to a rate in step 230 in column 5, lines 45-49, it appears that none of the references, including Gupta '843, teach the features that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas.

In view of the above arguments, it is respectfully submitted that a *prima facie* case of obviousness cannot be maintained. The cited references, taken alone or in combination, fail to teach or suggest all the claim limitations. Specifically, the cited prior art fails to disclose or suggest a discharge gas is not mixed with a reactive gas, or that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas.

Since Kozuka, Gupta '843 and Gupta '796, whether taken alone or in combination, do not teach or suggest all the claim limitations, a *prima facie* case of obviousness cannot be maintained. Accordingly, reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a) is in order and respectfully requested.

Mei, Kaschmitter and Yamazaki '076 do not cure the deficiencies in Kozuka, Gupta '843 and Gupta '796. The Official Action relies on Mei, Kaschmitter and Yamazaki '076 to teach the use of silicon oxide layers and crystallization using laser light (p. 8, Paper No. 30). The prior art, either alone or in combination, does not teach or disclose that the discharge gas is not mixed with the reactive gas or that an overall flow rate of gases supplied in the chamber is maintained during a transition from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. Since

Kozuka, Gupta '843, Gupta '796 and Mei, Kaschmitter and Yamazaki '076 do not teach or suggest all the claim limitations, a *prima facie* case of obviousness cannot be maintained.

For all of the above reasons, it is respectfully asserted that the pending claims of the present application are unobvious in view of the prior art of record. Reversal of the outstanding rejections of record and allowance of the claims of this application is requested.

B. Whether, under the doctrine of obviousness-type double patenting, claims 23-29, 45-50, 58-129 are not an obvious variation of or are patentably distinct from the combination of either claims 1-63 of U.S. Patent No. 6,281,147 B1 to Yamazaki et al., or claims 1-5, 12-21 and 27-30 of U.S. Patent No. 6,015,762 to Yamazaki et al., Gupta '843 and/or Kozuka.

Paragraph 2 of the Official Action mailed November 2, 2002 (referring to Paper No. 33), and as amended by the "Supplement to Paper No. 37" mailed March 9, 2004, rejects claims 23-29, 45-50, 58-129 under the doctrine of obviousness-type double patenting over the combination of either claims 1-63 of U.S. Patent No. 6,281,147 B1 to Yamazaki et al., or claims 1-5, 12-21 and 27-30 of U.S. Patent No. 6,015,762 to Yamazaki et al., U.S. Patent No. 6,289,843 B1 to Gupta et al. and, optionally, U.S. Patent No. 5,420,044 to Kozuka.

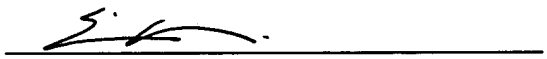
As stated in MPEP § 804, under the heading "Obviousness-Type," in order to form an obviousness-type double patenting rejection, a claim in the present application must define an invention that is merely an obvious variation of an invention claimed in the prior art patent, and the claimed subject matter must not be patentably distinct from the subject matter claimed in a commonly owned patent. Also, the patent principally underlying the double patenting rejection is not considered prior art.

The Applicant respectfully traverses the obviousness-type double patenting rejection because independent claims 23-29, 58, 64, 70, 76, 82, 87, 92 and 98 of the present invention are patentably distinct from the claims of either Yamazaki '147 or Yamazaki '762. Specifically, the independent claims of the present invention recite that an overall flow rate of gases supplied in a chamber is maintained during a transition

from the discharge gas to the reactive gas or from the reactive gas to the discharge gas. Yamazaki '147, Yamazaki '762, Gupta '843 and, optionally, Kozuka do not claim or disclose at least the above-referenced feature of the present invention. The Applicant respectfully submits that the present application is patentably distinct from the combination of either Yamazaki '147 or Yamazaki '762 with Gupta '843 and, optionally, Kozuka. Reconsideration of the obviousness-type double patenting rejection is requested.

The present application is believed to be in condition for allowance and favorable reconsideration is respectfully requested. If the Examiner feels further discussions would expedite prosecution of this application, he is invited to contact the undersigned.

Respectfully submitted,



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IX. APPENDICES

A. Claims involved in the appeal.

B. U.S. Patent No. 5,420,044 to Kozuka

C. U.S. Patent No. 6,289,843 B1 to Gupta et al.

D. U.S. Patent No. 5,456,796 to Gupta et al.

E. U.S. Patent No. 5,366,926 to Mei et al.

F. U.S. Patent No. 5,346,850 to Kaschmitter et al.

G. U.S. Patent No. 5,313,076 to Yamazaki et al.

H. U.S. Patent No. 6,281,147 B1 to Yamazaki et al.

I. U.S. Patent No. 6,015,762 to Yamazaki et al.

APPENDIX A

PENDING CLAIMS

23. A film forming method comprising the steps of:

supplying hydrogen gas into a chamber;

supplying radio frequency energy in said chamber to generate plasma from said hydrogen gas by radio frequency discharge;

supplying a reactive gas into said chamber at a same flow rate as supplying said hydrogen gas; and

forming a semiconductor film over a substrate in said chamber by decomposing said reactive gas using said radio frequency energy,

wherein the step of supplying said hydrogen gas is discontinued with a start of the step of supplying said reactive gas and throughout the forming of said semiconductor film, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said hydrogen gas to said reactive gas.

24. A film forming method comprising the steps of:

forming an under film on a substrate;

supplying hydrogen gas into a chamber;

supplying radio frequency energy in said chamber to generate plasma from said hydrogen gas by radio frequency discharge;

supplying a reactive gas into said chamber at a same flow rate as supplying said hydrogen gas; and

forming a semiconductor film on said under film in said chamber by decomposing said reactive gas using said radio frequency energy,

wherein the step of supplying said hydrogen gas is discontinued with a start of the step of supplying said reactive gas and throughout the step of forming of said semiconductor film, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said hydrogen gas to said reactive gas.

25. A film forming method comprising the steps of:

forming a semiconductor film over a substrate in a chamber by decomposing a reactive gas using radio frequency energy supplied in said chamber;

supplying hydrogen gas into said chamber at a same flow rate as supplying said reactive gas; and

supplying said radio frequency energy to said hydrogen gas to maintain plasma from said hydrogen gas in said chamber by radio frequency discharge,

wherein said reactive gas is supplied into said chamber during the step of forming of said semiconductor film before the step of supplying said hydrogen gas, and the step of supplying said hydrogen gas is started with discontinuing a supply of said reactive gas, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said reactive gas to said hydrogen gas.

26. A film forming method comprising the steps of:

supplying a discharge gas into a chamber;

supplying a radio frequency energy in said chamber to generate plasma from said discharge gas by radio frequency discharge;

supplying a reactive gas into said chamber at a same flow rate as supplying said discharge gas; and

forming a semiconductor film over a substrate in said chamber by decomposing said reactive gas using said radio frequency energy,

wherein the step of supplying said discharge gas is discontinued with a start of the step of supplying said reactive gas and throughout the step of forming of said semiconductor film,

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said discharge gas to said reactive gas, and

wherein said discharge gas does not contribute to film formation.

27. A film forming method comprising the steps of:

forming a semiconductor film over a substrate in a chamber by decomposing a reactive gas using radio frequency energy supplied in said chamber;

supplying a discharge gas into said chamber at a same flow rate as supplying said reactive gas; and

supplying said radio frequency energy to said discharge gas to maintain plasma from said discharge gas in said chamber by radio frequency discharge,

wherein said reactive gas is supplied into said chamber during the step of forming of said semiconductor film before the step of supplying a discharge gas, and the step of supplying said discharge gas is started with discontinuing supplying said reactive gas,

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said reactive gas to said discharge gas, and

wherein said discharge gas does not contribute to film formation.

28. A film forming method for forming a plurality of different films as a multilayer in a multichamber apparatus comprising a plurality of chambers coupled to each other, said method comprising the steps of:

supplying hydrogen gas into one of said chambers;

supplying radio frequency energy in said one of said chambers to generate plasma from said hydrogen gas by radio frequency discharge;

supplying a reactive gas into said one of said chambers at a same flow rate as supplying said hydrogen gas; and

forming a semiconductor film over a substrate as one of said different films in said one of said chambers by decomposing said reactive gas using said radio frequency energy therein,

wherein the step of supplying said hydrogen gas is discontinued with a start of the step of supplying said reactive gas and throughout the step of forming of said semiconductor film, and wherein each of said chambers forms at least one of said plurality of different films, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said hydrogen gas to said reactive gas.

29. A film forming method for forming a plurality of different films as a multilayer in a multichamber apparatus comprising a plurality of chambers coupled to each other, said method comprising the steps of:

forming a semiconductor film over a substrate as one of said different films in one of said chambers by decomposing a reactive gas using radio frequency energy supplied in said one of said chambers;

supplying hydrogen gas into said one of said chambers at a same flow rate as supplying said reactive gas; and

supplying said radio frequency energy to said hydrogen gas to maintain plasma from said hydrogen gas in said one of said chambers by radio frequency discharge,

wherein said reactive gas is supplied into said chamber during the step of forming of said semiconductor film before the step of supplying said hydrogen gas, and the step of supplying said hydrogen gas is started with discontinuing the supplying of said reactive gas, and wherein each of said chambers forms at least one of said plurality of different films, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said reactive gas to said hydrogen gas.

31. A method according to claim 23 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

32. A method according to claim 24 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

33. A method according to claim 25 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

34. A method according to claim 26 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

35. A method according to claim 27 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

36. A method according to claim 28 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

37. A method according to claim 29 wherein said semiconductor film is crystallized by irradiating said semiconductor film with a laser light, and said crystallized semiconductor film is used for fabricating a thin film transistor.

38. A method according to claim 31 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

39. A method according to claim 32 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

40. A method according to claim 33 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

41. A method according to claim 34 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

42. A method according to claim 35 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

43. A method according to claim 36 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

44. A method according to claim 37 wherein said thin film transistor is a top-gate thin film transistor or a bottom-gate thin film transistor.

45. A method according to claim 23 wherein a period of time from a start of said radio frequency discharge to said start of the supply of said reactive gas is 10 seconds.

46. A method according to claim 24 wherein a period of time from a start of said radio frequency discharge to said start of the supply of said reactive gas is 10 seconds.

47. A method according to claim 28 wherein a period of time from a start of said radio frequency discharge to said start of the supply of said reactive gas is 10 seconds.

48. A method according to claim 23 wherein a time chart in said film forming is $10t \geq T$ where t is a largest period of time selected among periods of time corresponding to an unstable discharge state of a start of discharge, and where T is a period of time of the forming of said semiconductor film.

49. A method according to claim 24 wherein a time chart in said film forming is $10t \geq T$ where t is a largest period of time selected among periods of time corresponding to an unstable discharge state of a start of discharge, and where T is a period of time of the forming of said semiconductor film.

50. A method according to claim 26 wherein a time chart in said film forming is $10t \geq T$ where t is a largest period of time selected among periods of time

corresponding to an unstable discharge state at a start of discharge, and where T is a period of time of the forming of said semiconductor film.

58. A film forming method for fabricating a thin film transistor comprising the steps of:

supplying a discharge gas into a chamber;

supplying radio frequency energy in said chamber to generate plasma from said discharge gas by radio frequency discharge;

supplying a reactive gas into said chamber at a same flow rate as supplying said discharge gas; and

forming a gate insulating film over an insulating substrate in said chamber by decomposing said reactive gas using said radio frequency energy,

wherein said discharge gas is not supplied during the step of supplying said reactive gas and throughout the forming of said gate insulating film, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said discharge gas to said reactive gas.

59. A method according to claim 58 wherein said thin film transistor is a bottom gate thin film transistor.

60. A method according to claim 58 wherein said gate insulating film is silicon oxide.

61. A method according to claim 58 wherein said discharge gas is hydrogen.

62. A method according to claim 58 wherein said reactive gas is silane.

63. A method according to claim 58 wherein a period of time from the start of said radio frequency discharge to the start of the supply of said reactive gas is 10 seconds.

64. A film forming method for fabricating a thin film transistor comprising the steps of:

forming a gate insulating film over an insulating substrate in a chamber by decomposing a reactive gas using radio frequency energy supplied in said chamber;

supplying a discharge gas into said chamber; and

supplying said radio frequency energy to said discharge gas to maintain plasma from said discharge gas in said chamber by radio frequency discharge at a same flow rate as supplying said reactive gas,

wherein said reactive gas is supplied into said chamber during the step of forming of said gate insulating film before the step of supplying said discharge gas, and said reactive gas is not supplied during the step of supplying said discharge gas, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said reactive gas to said discharge gas.

65. A method according to claim 64 wherein said thin film transistor is a bottom gate thin film transistor.

66. A method according to claim 64 wherein said gate insulating film is silicon oxide.

67. A method according to claim 64 wherein said discharge gas is hydrogen.

68. A method according to claim 64 wherein said reactive gas is silane.

69. A method according to claim 64 wherein said radio frequency discharge is continued for 15 seconds after supplying said discharge gas.

70. A film forming method for fabricating a thin film transistor comprising the steps of:

supplying a discharge gas into a chamber;

supplying radio frequency energy in said chamber to generate plasma from said discharge gas by radio frequency discharge;

supplying a reactive gas into said chamber at a same flow rate as supplying said discharge gas; and

forming a semiconductor film over an insulating substrate in said chamber by decomposing said reactive gas using said radio frequency energy,

wherein said discharge gas is not supplied during the step of supplying said reactive gas and throughout the forming of said semiconductor film, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said discharge gas to said reactive gas.

71. A method according to claim 70 wherein said thin film transistor is a bottom gate thin film transistor.

72. A method according to claim 70 wherein said discharge gas is hydrogen.

73. A method according to claim 70 wherein said reactive gas is silane.

74. A method according to claim 70 wherein a period of time from the start of said radio frequency discharge to the start of the supply of said reactive gas is 10 seconds.

75. A method according to claim 70 wherein a thickness of said semiconductor film is 50 nm or less.

76. A film forming method for fabricating a thin film transistor comprising the steps of:

forming a semiconductor film over an insulating substrate in a chamber by decomposing a reactive gas using radio frequency energy supplied in said chamber;

supplying a discharge gas into said chamber at a same flow rate as supplying said reactive gas; and

supplying said radio frequency energy to said discharge gas to maintain plasma from said discharge gas in said chamber by radio frequency discharge,

wherein said reactive gas is supplied into said chamber during the step of forming of said semiconductor film before the step of supplying said discharge gas, and said reactive gas is not supplied during the step of supplying said discharge gas, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said reactive gas to said discharge gas.

77. A method according to claim 76 wherein said thin film transistor is a bottom gate thin film transistor.

78. A method according to claim 76 wherein said discharge gas is hydrogen.

79. A method according to claim 76 wherein said reactive gas is silane.

80. A method according to claim 76 wherein said radio frequency discharge is continued for 15 seconds after supplying said discharge gas.

81. A method according to claim 76 wherein a thickness of said semiconductor film is 50 nm or less.

82. A film forming method for fabricating a thin film transistor comprising the steps of:

supplying a discharge gas into a chamber;

supplying radio frequency energy in said chamber to generate plasma from said discharge gas by radio frequency discharge;

supplying a reactive gas into said chamber at a same flow rate as supplying said discharge gas; and

forming an under film on an insulating substrate in said chamber by decomposing said reactive gas using said radio frequency energy,

wherein said discharge gas is not supplied during the step of supplying said reactive gas and throughout the forming of said under film, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said discharge gas to said reactive gas.

83. A method according to claim 82 wherein said under film is silicon oxide.

84. A method according to claim 82 wherein said discharge gas is hydrogen.

85. A method according to claim 82 wherein said wherein said reactive gas is silane.

86. A method according to claim 82 wherein a period of time from the start of said radio frequency discharge to the start of the supply of said reactive gas is 10 seconds.

87. A film forming method for fabricating a thin film transistor comprising the steps of:

forming an under film on an insulating substrate in a chamber by decomposing a reactive gas using radio frequency energy supplied in said chamber;

supplying a discharge gas into said chamber at a same flow rate as supplying said reactive gas; and

supplying said radio frequency energy to said discharge gas to maintain plasma from said discharge gas in said chamber by radio frequency discharge,

wherein said reactive gas is supplied into said chamber during the step of forming of said under film before the step of supplying said discharge gas, and said reactive gas is not supplied during the step of supplying said discharge gas, and

wherein an overall flow rate of gases supplied in said chamber is maintained during a transition from said reactive gas to said discharge gas.

88. A method according to claim 87 wherein said under film is silicon oxide.

89. A method according to claim 87 wherein said discharge gas is hydrogen.

90. A method according to claim 87 wherein said reactive gas is silane.

91. A method according to claim 87 wherein said radio frequency discharge is continued for 15 seconds after supplying said discharge gas.

92. A film forming method for fabricating a thin film transistor comprising the steps of:

supplying a first discharge gas into a first chamber;

supplying first radio frequency energy in said first chamber to generate plasma from said first discharge gas by first radio frequency discharge;

supplying a first reactive gas into said first chamber at a same flow rate as supplying said first discharge gas; and

forming a semiconductor film over an insulating substrate in said first chamber by decomposing said first reactive gas using said first radio frequency energy,

supplying a second discharge gas into a second chamber;

supplying second radio frequency energy in said second chamber to generate plasma from said second discharge gas by second radio frequency discharge;

supplying a second reactive gas into said second chamber at a same flow rate as supplying said second discharge gas; and

forming a gate insulating film on said semiconductor film in said second chamber by decomposing said second reactive gas using said second radio frequency energy,

wherein said first and said second discharge gases are not supplied during the step of supplying said first and said second reactive gases and throughout the forming of said semiconductor film and said gate insulating film, and

wherein an overall flow rate of gases supplied in said first chamber is maintained during a transition from said first discharge gas to said first reactive gas,

and an overall flow rate of gases supplied in said second chamber is maintained during a transition from said second discharge gas to said second reactive gas.

93. A method according to claim 92 wherein said thin film transistor is a bottom gate thin film transistor.

94. A method according to claim 92 wherein said first and said second discharge gases are hydrogen.

95. A method according to claim 92 wherein said first and said second reactive gases are silane.

96. A method according to claim 92 wherein a period of time from the start of said first or said second radio frequency discharge to the start of the supply of said first or second reactive gas is 10 seconds.

97. A method according to claim 92 wherein a thickness of said semiconductor film is 50 nm or less.

98. A film forming method for fabricating a thin film transistor comprising the steps of:

forming a semiconductor film over an insulating substrate in a first chamber by decomposing a first reactive gas using first radio frequency energy supplied in said first chamber;

supplying a first discharge gas into said first chamber at a same flow rate as supplying said first reactive gas; and

supplying said first radio frequency energy to said first discharge gas to maintain plasma from said first discharge gas in said first chamber by first radio frequency discharge,

forming a gate insulating film on said semiconductor film in a second chamber by decomposing a second reactive gas using second radio frequency energy supplied in said second chamber;

supplying a second discharge gas into said second chamber at a same flow rate as supplying said second reactive gas; and

supplying said second radio frequency energy to said second discharge gas to maintain plasma from said second discharge gas in said second chamber by second radio frequency discharge,

wherein said first and said second reactive gases are supplied into said first and said second chambers during the step of forming of said semiconductor film and said gate insulating film before the step of supplying said first and said second discharge gases, and said first and said second reactive gases are not supplied during the step of supplying said first and said second discharge gases, and

wherein an overall flow rate of gases supplied in said first chamber is maintained during a transition from said first reactive gas to said first discharge gas, and an overall flow rate of gases supplied in said second chamber is maintained during a transition from said second reactive gas to said second discharge gas.

99. A method according to claim 98 wherein said thin film transistor is a bottom gate thin film transistor.

100. A method according to claim 98 wherein said first and said second discharge gases are hydrogen.

101. A method according to claim 98 wherein said first and said second reactive gases are silane.

102. A method according to claim 98 wherein said first or said second radio frequency discharge is continued for 15 seconds after supplying said first or said second discharge gas.

103. A method according to claim 98 wherein a thickness of said semiconductor film is 50 nm or less.

104. A method according to claim 23 wherein said flow rate of said hydrogen gas is 100 sccm.

105. A method according to claim 24 wherein said flow rate of said hydrogen gas is 100 sccm.

106. A method according to claim 25 wherein said flow rate of said hydrogen gas is 100 sccm.

107. A method according to claim 26 wherein said flow rate of said discharge gas is 100 sccm.

108. A method according to claim 27 wherein said flow rate of said discharge gas is 100 sccm.

109. A method according to claim 28 wherein said flow rate of said hydrogen gas is 100 sccm.

110. A method according to claim 29 wherein said flow rate of said hydrogen gas is 100 sccm.

111. A method according to claim 58 wherein said flow rate of said discharge gas is 100 sccm.

112. A method according to claim 64 wherein said flow rate of said reactive gas is 100 sccm.

113. A method according to claim 70 wherein said flow rate of said discharge gas is 100 sccm.

114. A method according to claim 76 wherein said flow rate of said reactive gas is 100 sccm.

115. A method according to claim 82 wherein said flow rate of said discharge gas is 100 sccm.

116. A method according to claim 87 wherein said flow rate of said reactive gas is 100 sccm.

117. A method according to claim 92 wherein said flow rate of said first and said second discharge gases is 100 sccm.

118. A method according to claim 98 wherein said flow rate of said first and said second reactive gases is 100 sccm.

119. A method according to claim 23 wherein said semiconductor film is amorphous silicon.

120. A method according to claim 24 wherein said semiconductor film is amorphous silicon.

121. A method according to claim 25 wherein said semiconductor film is amorphous silicon.

122. A method according to claim 26 wherein said semiconductor film is amorphous silicon.

123. A method according to claim 27 wherein said semiconductor film is amorphous silicon.

124. A method according to claim 28 wherein said semiconductor film is amorphous silicon.

125. A method according to claim 29 wherein said semiconductor film is amorphous silicon.

126. A method according to claim 70 wherein said semiconductor film is amorphous silicon.

127. A method according to claim 76 wherein said semiconductor film is amorphous silicon.

128. A method according to claim 92 wherein said semiconductor film is amorphous silicon.

129. A method according to claim 98 wherein said semiconductor film is amorphous silicon.